



Seminar, LBL, 11 December 2003

An Australian Perspective on Distributed Energy Resources

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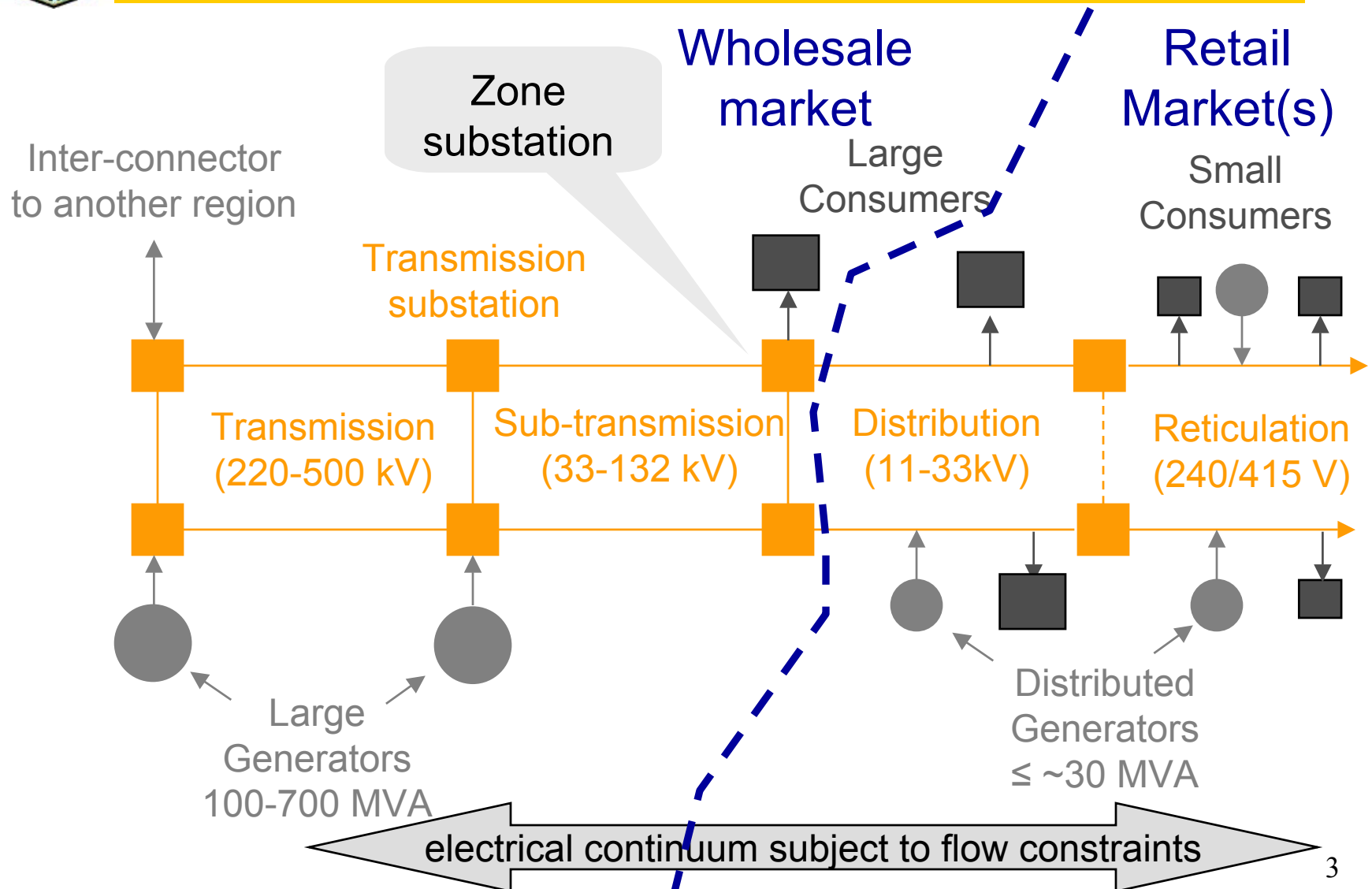


Outline

- DER in a restructured electricity industry
- Barriers to DER in Australia & responses:
 - Physical issues:
 - Network connection & system operation
 - Commercial issues
 - Market signals for operation & investment
 - Legal accountability issues:
 - Shared responsibility for supply availability & quality
 - Regulatory issues:
 - Economic, environmental, technical

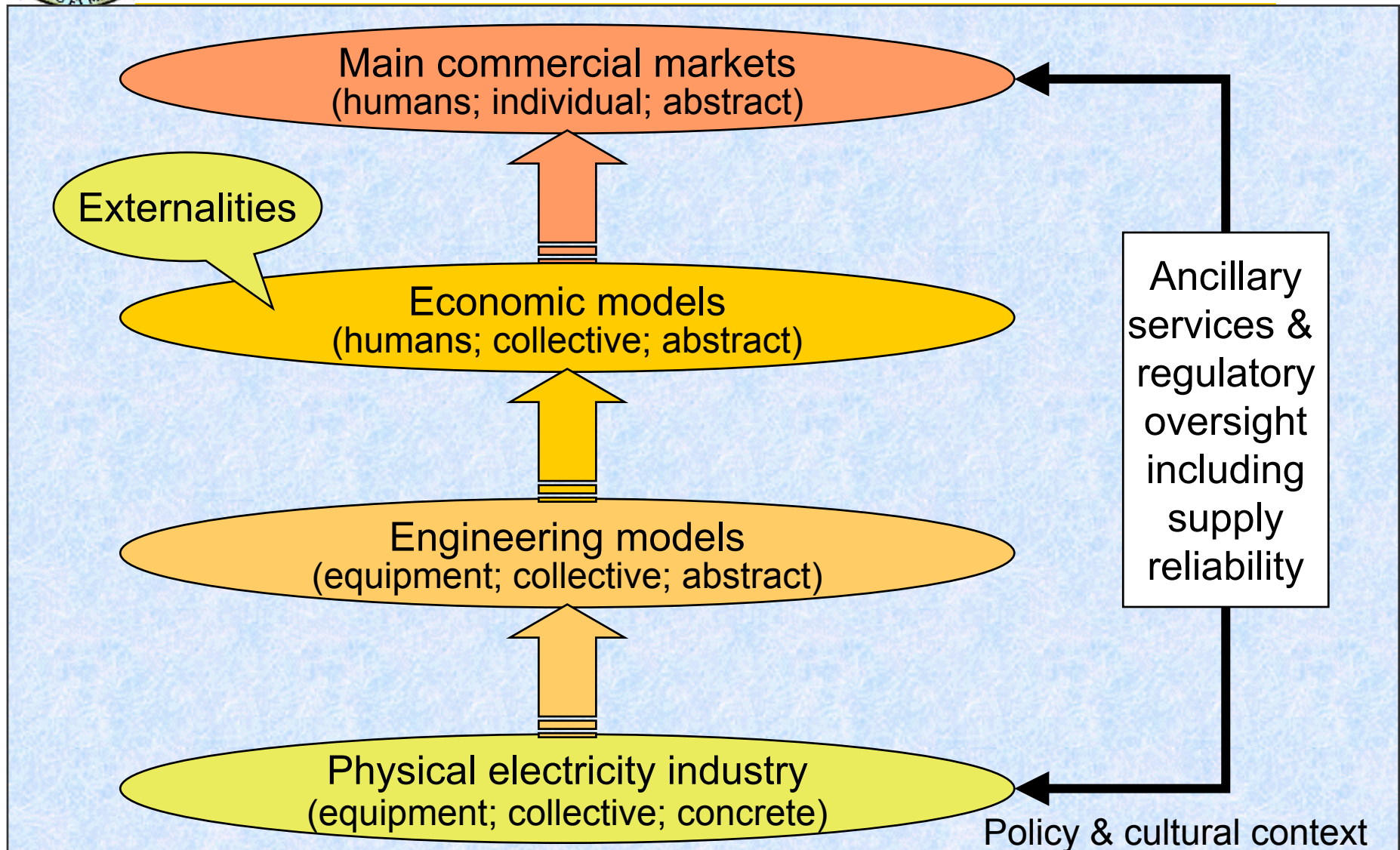


DER in a restructured electricity industry





The central challenge of electricity restructuring: *to make economics & engineering compatible*





Timeline for electricity trading

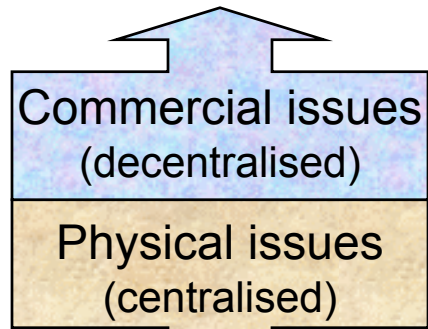
(need location detail & active demand-side participation)

□ □ uncertainty increases looking forward

Financial instrument
(derivative) trading &
spot market projections

Spot market
for period t

Spot market
for period $t+1$



time

spot
period t

spot
period $t+1$

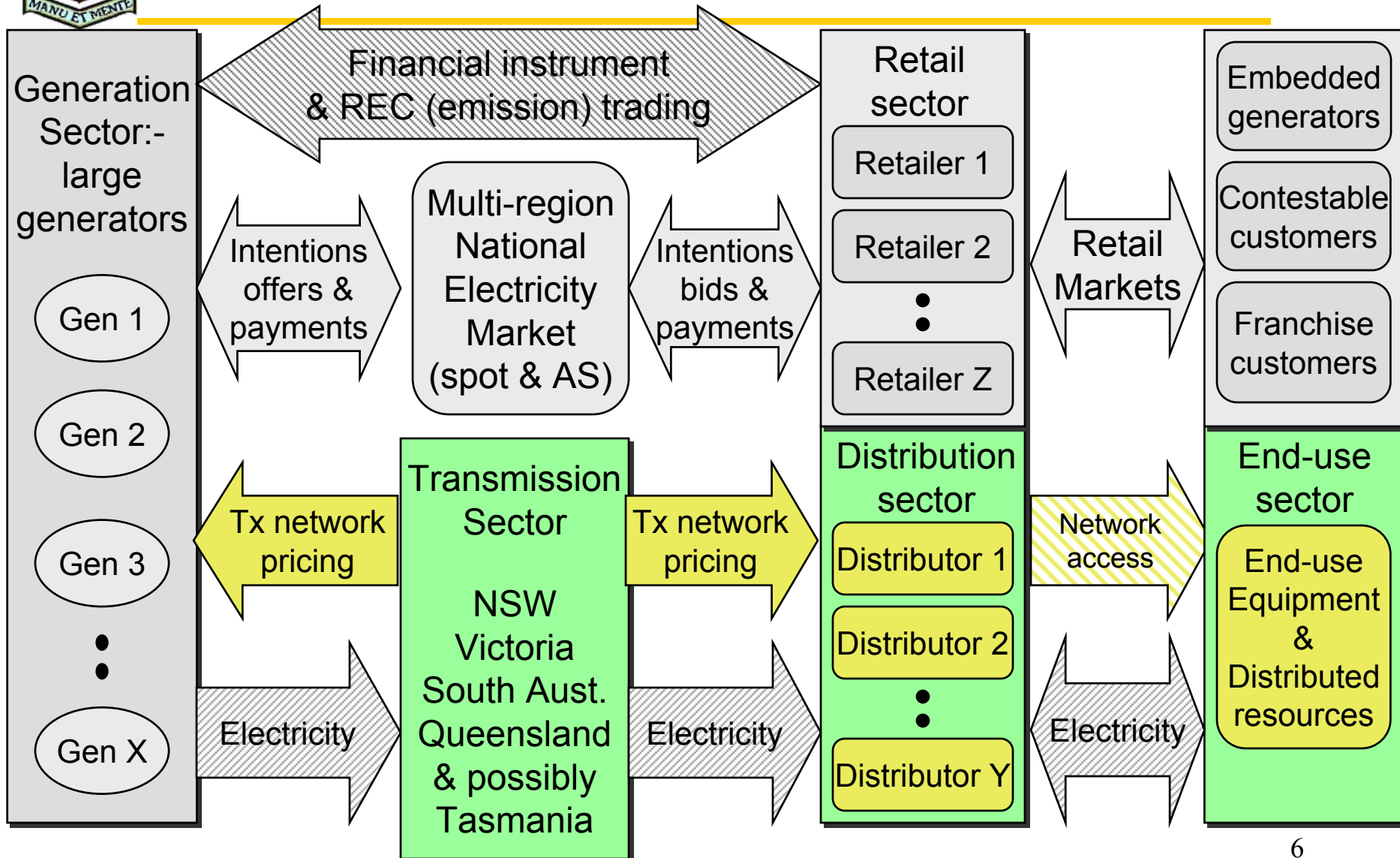
ancillary service
“actuation markets”
for period t

ancillary service
“actuation markets”
for period $t+1$

forward-looking ancillary service
(AS) “acquisition markets”
& reliability assessment
(PASA, SOO)



Electricity industry structure in SE Australia





DER in the Australian restructured electricity industry

- Wholesale market (design is maturing):
 - Large generators (sellers), retailers (buyers)
- Retail markets (design is immature):
 - Retailers (sellers), end-users (buyers), DER
- Regulated transmission & distribution:
 - Network provides an imperfect “trading floor”

Provides an ambiguous context for DER:

- Can location costs & benefits be identified & valued? (uncertainty is itself a barrier)



Electricity industry behaviour that is difficult to commercialise

- Continuous, shared energy flow from power stations to end-use equipment via network:
 - Instantaneously variable with time & location
 - Availability & quality can degrade rapidly
- Shared accountability for availability & quality
 - High-value end-uses have high commercial risks
 - Managed *collectively* by *ancillary services* (AS):
 - Quality (frequency, voltage), Availability & Safety (including security and fault detection & clearance)
 - Network plays an important “aggregation” role in AS



Potential benefits of DER

- Reduce costs of end-use energy services:
 - Displace investment in network & remote generation
 - Reduce network losses
 - Improve utilisation of primary energy resources
- Reduce environmental impacts:
 - Improve end-use efficiency
 - Increase use of renewable energy
- Improve robustness to equipment damage



Key questions concerning DER

- Are benefits of DER real and measurable?
 - Network aggregation role difficult to replicate:
 - In both operation and investment
- Does DER have costs as well as benefits?
 - Operation & protection issues are complex
 - Sometimes local environmental impacts
- Can a restructured industry deliver appropriate outcomes for DER?
 - Requires a complex combination of centralised & de-centralised decision making



Physical issues:- *historical inheritance*

- Large generators remote from load centres
- Re-configurable radial distribution networks
- Power system design & operating protocols:
 - Assume no “tidal” energy flows
- End-use equipment & interface design:
 - Assumes “obligation to serve” & averaged cost-recovery
 - Network service not adequately measured

Not designed to exploit potential DER benefits



Physical issues:- *a way forward*

- Physical behaviour likely to remain centrally managed:
 - End-users & DG owners should participate fully in industry planning & operation
 - Supply & demand side options should receive equal consideration in planning & operation
 - Industry performance measures should be based on energy service delivery
 - Interval energy & supply availability & quality should be measured for all network users



Commercial issues:- *current status*

- Australia's National Electricity Market:
 - Network representation limited to interconnectors
- Retail market & NSP contracts:
 - Lack appropriate commercial instruments for:
 - Distribution network AS, spot & forward energy
- Metering at end-user points of connection:
 - Does not always record spot market energy, let alone availability & quality of supply



Commercial issues:- *a way forward*

- Roll-out interval metering that measures energy, availability & quality
- Improve end-user technology & decision-making by introducing:
 - End-use facilitators
 - Innovative end-use technology & controllers
 - Physical & financial risk management



Accountability issues: *current status*

- Physical accountability:
 - Death, injury, damage to equipment
 - Non-delivery of end-use service(s):
 - May be due to either availability or quality problems
- Commercial & legal accountability:
 - Accountability for poor availability & quality of supply is ambiguous - NSP or other parties?
 - Legal context needs clarification



Accountability issues: *a way forward*

- Clarify legal accountability for poor availability & quality of supply
- Replace implied “obligation to serve” with clear contracts with mutual obligations:
 - AS, spot & forward energy
 - Distribution network services
- Implement compatible contracts for end-users and distributed generators



Regulatory issues:- *current status*

- Economic regulation of NSPs:
 - Approved investment based on forecast demand with associated cost-recovery tariffs
- Technical regulation:
 - By standards & connection requirements that are not always technology neutral
- Environmental regulation:
 - Inadequate attention to climate change impacts



Regulatory issues:- *a way forward*

- Economic regulation of NSPs:
 - Introduce risk-sharing arrangements
- Technical regulation:
 - Modify towards technology neutrality
- Environmental regulation:
 - Introduce effective regulation of climate change impacts:
 - Taxes or tradeable emission permits appear to be the best options but may require Federal action



Summary of DER issues

- Physical issues:
 - Complexity; importance of extreme events
- Commercial issues:
 - Dysfunctional retail markets; monopoly NSPs; importance of ancillary services
- Accountability issues:
 - Shared physical responsibility
 - Legal & commercial ambiguity
- Regulatory issues:
 - Progress needed in all areas



On-going research activities at UNSW

- Grid connection guidelines and standards
- Retail market design (AS, energy, derivatives)
- Legal liability issues
- Regulatory methodologies
- For further information:
 - Proceedings of a Workshop on DG-Network Issues, University of New South Wales, 27 May 2002
 - Available from: <http://www.acre.ee.unsw.edu.au>
 - Other relevant UNSW research at:
 - www.ergo.ee.unsw.edu.au